

Syracuse, New York, 1st: bright auroral streamers were visible at 10 p. m.

Portsmouth, Ohio, 1st: an auroral light was observed in the northwestern sky at 11 p. m.

Richmond, Kentucky, 1st: from 9 to 11 p. m., an auroral arch was visible extending from northeast to northwest and to an altitude of 10°; occasional faint streamers were also observed.

Vevay, Indiana, 1st: at 11 p. m., an auroral light extended from north-northwest to northeast; beams of hazy light reached the zenith; the display continued until after midnight.

Burlington, Iowa, 1st: an aurora was observed at 10.45 p. m.; it appeared in the northwestern sky and extended from the horizon to an altitude of 50°. The rays of white light blended into purple, presenting a beautiful appearance for about five minutes.

Port Angeles, Washington Territory, 1st: a faint aurora was observed in the north at 7 p. m.; it remained visible for about one and one-half hours, resembling in appearance the morning dawn.

At Pysht, Washington Territory, an auroral light was visible at 4 a. m. on the 1st.

Displays observed on other dates during the month are as follows:

2d.—Sidney, Nova Scotia; Eastport and Orono, Maine; Oswego, New York; Moorhead, Minnesota.

4th.—Allison, Kansas.

6th.—Eastport, Maine; Alpena and Ionia, Michigan; Winnipeg, Manitoba.

7th.—Hartford, Connecticut.

9th.—Alpena and Escanaba, Michigan; Webster, Dakota; Winnipeg, Manitoba.

12th.—Winnipeg, Manitoba.

13th.—Escanaba, Michigan.

14th.—Eastport, Maine.

15th.—Charlottetown, Prince Edward Island; Gardiner, Maine; Winnipeg, Manitoba.

18th.—Eastport, Maine.

19th and 20th.—Winnipeg, Manitoba.

24th.—Eastport, Maine; Huron, Dakota.

26th.—Eastport, Maine; Clay Centre, Kansas.

27th.—Clay Centre, Kansas.

28th.—Gardiner, Maine.

THUNDER-STORMS.

Thunder-storms were reported in the various states and territories as follows:

Alabama.—9th, 10th, 19th, 20th.

Arizona.—5th, 6th, 10th, 13th, 14th, 18th, 22d, 23d, 24th, 26th.

California.—1st, 9th, 12th, 16th, 18th, 19th.

Colorado.—West Las Animas, 19th.

Connecticut.—Bethel, 14th; Colebrook and New Haven, 12th.

Dakota.—1st, 2d, 4th, 6th.

Delaware.—Delaware Breakwater, 12th.

Florida.—2d, 4th, 6th, 9th to 14th, 19th to 23d.

Georgia.—9th, 10th, 22d, 30th.

Idaho.—13th, 14th, 17th, 18th.

Illinois.—1st, 3d, 4th, 5th, 7th, 8th, 16th.

Indiana.—1st, 2d, 4th, 5th, 7th, 16th, 21st.

Iowa.—1st, 3d, 4th, 6th, 7th, 11th, 16th, 20th.

Kansas.—1st, 3d, 5th, 6th, 7th, 20th.

Kentucky.—1st, 2d, 4th, 7th to 12th, 15th.

Louisiana.—2d, 3d, 4th, 19th to 22d, 26th.

Maine.—12th, 13th.

Massachusetts.—3d, 4th, 6th, 12th, 13th, 18th.

Michigan.—1st to 5th, 8th, 12th, 15th, 16th, 19th, 21st.

Minnesota.—2d, 6th, 20th.

Nebraska.—1st, 3d, 4th, 6th.

Nevada.—Carson City, 12th, 16th.

New Jersey.—6th, 12th, 28th.

New York.—1st, 4th, 6th, 12th, 13th, 16th to 19th, 22d.

North Carolina.—1st, 9th, 10th, 12th, 30th.

Ohio.—1st, 4th, 5th, 7th, 8th, 16th, 21st, 31st.

Oregon.—12th, 16th, 17th.

Pennsylvania.—1st, 4th, 7th, 8th, 11th, 12th, 17th, 18th.

Rhode Island.—Providence, 12th; Point Judith, 12th, 18th.

South Carolina.—Stateburg, 8th, 9th.

Tennessee.—1st, 7th, 8th, 10th, 21st.

Texas.—2d, 3d, 4th, 6th, 7th, 9th, 10th, 12th, 14th, 15th, 18th to 23d, 25th.

Utah.—Salt Lake City, 14th.

Vermont.—4th, 6th, 12th, 13th, 19th.

Virginia.—2d, 8th, 9th, 12th, 22d.

Washington Territory.—11th, 12th, 13th, 17th, 18th, 24th.

Wisconsin.—3d to 6th, 16th, 18th, 31st.

REPORT OF THUNDER STORMS OBSERVED BY SPECIAL VOLUNTARY OBSERVERS, PREPARED BY PROF. H. A. HAZEN.

The total number reported was 461. Twenty or more occurred on the following days: 1st, 21; 4th, 60; 5th, 33; 6th, 24; 7th, 22; 8th, 35; 12th, 40; 16th, 24, and 22d, 24. On the 4th a trough-like depression of no great depth extended from southwest to northeast, central in Illinois. The storms were mostly grouped along the southeast border of the depression. On the 5th the storms were central in Illinois and Indiana in a south-southeast direction from the "low" and at an average distance of 600 miles. On the 8th storms were most frequent in Pennsylvania and Maryland, at a distance of 330 miles from "low," and toward the south-southwest. Comparing the number of storms by districts with the records of voluntary observers from 1851 to 1873 we have Table I. The districts are: i., New England and New York; ii., Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, and West Virginia; iii., Illinois, Indiana, Kentucky, Ohio, and Tennessee; iv., Michigan, Minnesota, and Wisconsin; v., Dakota, Iowa, Kansas, Missouri, Montana, and Nebraska. We see from this table a marked excess in the number of storms in all the districts, amounting over the whole country to nearly .5 storm per station.

TABLE I.—Mean number of thunder-storms in October at each station, by districts.

District.	1851-1873.		1884.		Difference.	
	Stations.	No.	Stations.	No.	Stations.	No.
I.....	12	1.41	33	1.85	+ 21	+ .44
II.....	10	1.38	50	1.72	+ 40	+ .34
III.....	14	1.58	36	2.56	+ 22	+ .98
IV.....	6	1.64	14	1.79	+ 8	+ .15
V.....	9	1.54	33	1.85	+ 24	+ .31
Total.....	51	1.49	166	1.95	+115	+ .46

TABLE II.—Mean number of thunder-storms per station in all districts for October; also mean declination range.

Year.	Stations.	No.	Departure.	Magnetic Declination.	Year.	Stations.	No.	Departure.	Magnetic Declination.
1851.....	33	1.21	+ .27	.....	1864.....	33	1.21	+ .27	1.44 — .12
1852.....	48	1.54	+ .05	.....	1865.....	60	1.73	+ .25	1.45 — .13
1853.....	32	1.12	+ .36	1.07 + .25	1866.....	65	1.21	+ .27	1.36 — .04
1854.....	48	1.71	+ .23	1.29 + .03	1867.....	83	1.37	+ .11	1.51 — .19
1855.....	47	1.64	+ .10	1.14 + .18	1868.....	49	1.65	+ .17	1.13 + .19
1856.....	47	2.09	+ .61	1.07 + .25	1869.....	49	1.08	+ .40	1.58 + .26
1857.....	18	1.28	+ .20	0.99 + .33	1870.....	63	1.44	+ .04	1.14 + .18
1858.....	62	1.92	+ .44	1.69 + .23	1871.....	60	1.30	+ .18	1.59 + .27
1859.....	65	1.52	+ .04	1.62 + .30	1872.....	77	1.44	+ .04	1.19 + .13
1860.....	60	1.53	+ .05	1.73 + .41	1873.....	61	1.34	+ .14	1.16 + .16
1861.....	77	1.58	+ .10	1.48 + .16	Mean.....	.....	1.48	.....	1.32.....
1862.....	28	1.93	+ .45	1.25 + .07					
1863.....	34	1.20	+ .28	1.30 + .04					

Table ii. gives values of mean number of storms for each October from 1851 to 1873, and also the mean diurnal range of magnetic declination at Trevaudrum. If these figures be projected graphically there will be found a partial coincidence between the maximum and minimum points in each curve. The fluctuations however are small.

OPTICAL PHENOMENA.

SOLAR HALOS.

Solar halos were observed during October, in the several districts as follows:

New England.—Hartford, Connecticut, 29th; Cornish, Maine, 8th, 29th; Orono, Maine, 29th; Somerset, Massachusetts, 2d.

Middle Atlantic states.—Baltimore, Maryland, 26th; Cape

May, New Jersey, 26th; Dyberry, Pennsylvania, 26th; Wellsborough, Pennsylvania, 21st, 23d; Variety Mills, Virginia, 26th; Dale Enterprise, Virginia, 24th.

South Atlantic states.—Hatteras, North Carolina, 10th, 28th; Stateburg, South Carolina, 16th, 23d, 25th.

Florida peninsula.—Key West, 2d; Archer, 9th.

West Gulf states.—Fort Smith, Arkansas, 24th, 30th; Little Rock, Arkansas, 24th; Lead Hill, Arkansas, 1st, 22d, 25th, 28th; Point Pleasant, Louisiana, 24th.

Tennessee.—Nashville, 20th, 25th, 28th, 31st.

Ohio valley.—Pittsburg, Pennsylvania, 17th; Frankfort, Kentucky, 14th.

Lower lake region.—Erie, Pennsylvania, 15th; Buffalo, New York, 7th, 11th, 15th, 16th, 26th, 29th; Cleveland, Ohio, 26th; Oswego, New York, 26th; North Volney, New York, 26th; Palermo, New York, 29th; Wauseon, Ohio, 14th, 15th, 17th, 26th.

Upper lake region.—Escanaba, Michigan, 10th, 17th, 28th; Grand Haven, 9th, 10th, 26th; Milwaukee, Wisconsin, 11th; Riley, Illinois, 11th, 14th, 17th, 27th, 29th; Thornville, Michigan, 7th.

Upper Mississippi valley.—La Crosse, Wisconsin, 14th; Keokuk, Iowa, 13th, 25th; Davenport, Iowa, 6th, 11th, 27th, 29th.

Middle slope.—Fort Elliott, Texas, 23d; Independence, Kansas, 24th; Yates Centre, Kansas, 20th, 24th, 25th, 29th; Maud, Kansas, 24th.

Middle plateau.—Salt Lake City, Utah, 27th; Nephi, Utah, 15th, 27th.

Northern plateau.—Dayton, Washington Territory, 19th; Boise City, Idaho, 6th, 27th.

Middle Pacific coast region.—San Francisco, California, 5th, 18th, 24th, 27th, 28th, 31st; Cape Mendocino, California, 29th; Oakland, California, 28th.

LUNAR HALOS.

During October lunar halos were observed in the several districts as follows:

New England.—1st to 4th, 8th, 26th, 29th.

Middle Atlantic states.—1st, 4th, 5th, 6th, 24th, 25th, 26th, 31st.

South Atlantic states.—1st to 7th, 24th, 26th, 28th to 31st.

Florida peninsula.—Key West, 5th, 29th.

Eastern Gulf states.—1st, 4th, 6th, 23d, 25th, 26th, 29th, 30th.

Western Gulf states.—1st to 4th, 6th, 24th, 28th.

Rio Grande valley.—Brownsville, Texas, 24th.

Ohio valley.—1st, 2d, 25th, 27th to 30th.

Lower lake region.—Cleveland, Ohio, 2d; Buffalo New York, 6th; Palermo, New York, 28th.

Upper lake region.—1st, 3d to 6th, 27th to 31st.

Extreme northwest.—Fort Buford, Dakota, 4th; Saint Vincent, Minnesota, 24th.

Upper Mississippi valley.—1st, 3d, 5th, 26th, 28th to 31st.

Missouri valley.—5th, 29th, 31st.

Northern slope.—27th, 29th, 30th.

Middle slope.—1st, 2d, 24th, 29th, 30th.

Southern slope.—Fort Stockton, Texas, 4th.

Southern plateau.—Fort Apache, Arizona, 11th.

Middle plateau.—Salt Lake City, Utah, 27th, 29th; Nephi, Utah, 27th.

Northern plateau.—Boise City, Idaho, 1st, 5th, 6th, 30th.

North Pacific coast region.—6th, 7th, 10th, 27th, 28th, 29th.

Middle Pacific coast region.—12th, 26th to 29th, 31st.

The phases of the moon during the month were: full moon, 4th, 4.54 p. m.; last quarter, 11th, 9.23 a. m.; new moon, 18th, 7.25 p. m.; first quarter, 26th, 11.48 a. m.; perigee, 7th, 9 a. m.; apogee, 23d, 8 a. m.

MIRAGE.

San Francisco, California, a mirage was observed off the Berkeley shore during the afternoon of the 8th.

New London, Connecticut, a mirage was visible from 6.55 to 8.25 a. m. on the 15th.

Salina, Kansas, 23d.

Galveston, Texas, a mirage was observed at 12.49 p. m. on the 10th.

Indianola, Texas, 9th, 27th.

Marquette, Nebraska, 14th, 17th.

MISCELLANEOUS PHENOMENA.

SUNSETS.

The characteristics of the sky, as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service stations. Reports from one hundred and fifty-eight stations show 4,887 observations to have been made, of which four were reported doubtful; of the remainder, 4,883, there were 4,232, or 86.7 per cent., followed by the expected weather.

SUN GLOWS.

The sun glows, reports of which have been published in previous REVIEWS, were as extensively observed during October as in the preceding months, the displays having the same characteristics as those heretofore described. The dates on which this phenomenon has been noted in the several states and territories by the regular and voluntary observers of the Signal Service are published below. Where the phenomenon was observed at sunrise it is so stated, and where the dates only are given they refer to the displays at sunset.

Arizona.—Fort Bowie, 26th.

Arkansas.—Lead Hill, 1st, 2d, 4th, 6th, 7th, 9th, 10th, 14th, 15th, 17th, 18th, 22d, 31st.

California.—College City, 21st to 25th; San Francisco, 5th, both at sunrise and sunset, and on 10th at sunset; Red Bluff, 17th to 22d; Los Angeles, 2d to 8th, 13th to 17th, 20th to 24th, 26th, 27th, 28th, 31st.

Dakota.—Vermilion, 13th, 14th, 15th, 18th, resembling the bright displays of last fall; Yankton, 2d, 14th, 15th; Deadwood, 30th.

Florida.—Archer, 4th to 7th, 14th, 15th, 16th, 18th, 24th, 31st; Manatee, 5th to 8th; Key West, 15th; Pensacola, 4th to 7th.

Georgia.—Forsyth, 5th; Augusta, 13th, 14th, 17th, 18th, 23d, 30th, 31st; Atlanta, 1st, 5th, 6th, 9th, 11th, 12th, 17th.

Idaho.—Boisé City, 15th, 20th.

Indiana.—Vevay, at sunset, 3d, 4th, 5th, 9th, 12th, 14th, 15th, 19th, 23d, 28th, and at sunrise, 6th, 10th, 20th, 21st; Wabash, observed on all clear days during the month.

Iowa.—Cedar Rapids, observed on numerous evenings during the month and in two instances the light covered the sky; Muscatine, at sunrise, 5th, 6th, 9th, 10th, 11th, 13th, 20th and at sunset, 2d, 4th, 5th, 8th, 9th, 12th, 13th, 16th, 17th, 18th, 23d; Humboldt, at sunrise, 15th, 19th, and at sunset 3d, 14th, 16th; Manchester, 2d, 5th, 8th, 11th, 12th, 15th, 16th, 17th, 18th; Ottumwa, 10th, 14th, 15th, 16th, 18th; Davenport, 17th, 31st.

Kansas.—Wellington, 1st to 6th, 8th to 12th, 14th to 19th, 21st to 24th, 26th, 27th, 29th, 30th, 31st; Wyandotte, 17th, 19th.

Louisiana.—Grand Coteau, 17th.

Maine.—Eastport, 1st, 2d, 5th, 20th.

Maryland.—Fallston, 4th, 6th; Baltimore, 5th, 9th.

Massachusetts.—Somerset, 6th, 10th, 19th; Taunton, 18th; Thatcher's Island, 5th, 6th, 20th.

Michigan.—Mottville, on numerous evenings during the month; Detroit, 8th, 9th, 12th, 17th, 19th, 20th, 24th; Escanaba, 8th, 9th, 13th, 16th; Port Huron, 2d, 5th, 17th, 19th, 23d.

Minnesota.—Chester, 9th, 16th, 17th, 18th; Saint Paul, 5th, 18th.

Montana.—Fort Shaw, 16th; the sky presenting a fiery appearance of unusual brilliancy, the display lasting for one hour after sunset; Fort Maginnis, 17th, 22d; Fort Assinaboine, 3d, 16th, 22d, 23d, 26th.

Nebraska.—Red Willow, 8th, 22d, 23d.